

REMARKS/ARGUMENTS

Favorable reconsideration of this application in light of the following discussion is respectfully requested.

Claims 1-40 and 42-45 are presently active in this case, no claims amended herein.

In the outstanding Office Action, Claims 1-9 and 39 were rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Patent Publication 2002/0125240 to Ogura et al. in view of U.S. Patent No. 5,231,690 to Toya et al.; Claim 16 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Ogura et al. and Toya et al., and further in view of U.S. Patent No. 6,688,375 to Turner et al.; Claim 17 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Ogura et al. and Toya et al., and further in view of U.S. Patent No. 6,919,538 to Szekeresch et al.; Claim 29 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Ogura et al. and Toya et al., and further in view of U.S. Patent No. 6,106,628 to Takahashi et al.; Claims 30 and 31 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Ogura et al., Toya et al. and Takahashi, and further in view of Szekeresch et al.; and Claim 45 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Ogura et al., Toya et al., and further in view of U.S. Patent No. 6,353,209 to Schaper et al.

First, Applicants wish to thank Examiner Dhingra for the March 20, 2007 discussion at which time the outstanding issues in this case were discussed. Examiner Dhingra indicated that he will contact the undersigned when considering this response if further discussion is necessary.

Turning now to the merits, Applicants' invention is directed to a single wafer heater assembly in a substrate holder. As discussed in the background section of Applicants' specification, as wafers get bigger and device features get smaller, a better single wafer heater is needed to improve process performance. Thus, Applicants' invention is directed to a wafer

heater assembly having a more uniform heating characteristic and faster response times than a conventional single wafer heater.

Specifically, Applicants' Claim 1 recites a wafer heating assembly including a holding device having a wafer support surface configured to support a wafer, and a backside surface opposing the wafer support surface, the holding device comprising a plurality of recesses each having a middle portion extending along the wafer surface and end portions that extend to openings in said backside surface. Also recited is a plurality of heating units each mounted in a respective recess, wherein each heating unit includes a tube extending along the middle and end portions of the respective recess and having a carbon wire heater including a carbon fiber bundle, the carbon wire heater having a middle section sealed within the tube and opposing ends that extend to an exterior of the tube. At least one of the tube or an opposing end of the carbon wire heater extends through one of said openings on the backside surface of the holding device, and connecting terminals coupled to the opposing ends of the carbon wire heater. Finally, a mounting assembly is coupled to the holding device and configured to mount the wafer heating assembly to a processing chamber.

As disclosed in Applicants' specification, wafer heating assemblies covered by Claim 1 provide more uniform heating characteristics of the wafer, reduced thermal budgets for processing the wafer, faster throughput and reduced cost of ownership of the wafer processing apparatus.¹ Further, the inventive wafer heater assembly permits higher temperature ranges of operation with faster thermal gradients than a conventional heater system.²

The primary reference to Ogura et al. discloses a resistive heating device provided within a substrate holder. The outstanding Office Action acknowledges that Ogura et al. does not teach details of the heating unit such as the carbon wire heater formed of fibers enclosed

¹ Applicants' specification at paragraphs [0004] and [0091].

² Applicants' specification at paragraph [0096].

in a tube and having terminals.³ However, the Office Action cites the secondary reference to Toya et al. as correcting this deficiency.

Toya et al. discloses a carbon heater for use in the walls of semiconductor processing chamber. As seen in Figs. 1-28 of Toya et al., a flat plate carbon heater 10 is formed by encapsulating a carbon fiber heater member 11 within grooves of a quartz glass plate 12. The plate 12 can be shaped into a cylinder as shown in Fig. 27. As seen in Figs. 7-9, for example, the grooves can have various shapes to affect heating characteristics. However, there is no indication in Toya et al. that a heating element including a carbon fiber sealed in a tube is provided within a groove of the plate.

Fig. 33 shows an alternative embodiment wherein several tubes are arranged to form a cylindrical shape for heating an object within the cylinder. In this embodiment, the tubes form walls of the heater, but are not embedded within grooves of a solid member.

Finally, as seen in Figs. 78-81 (cited in the Office Action) the carbon heater 510 includes an upper container 512 and a lower container 511 that come together to form a disk shaped carbon heater 510. The lower container 511 includes recesses 516 therein for receiving a carbon fiber such that when the upper container is connected to the lower container the carbon fiber is contained within a closed volume formed by the upper and lower containers. Thus, the assembly of the containers seals the carbon fiber therein.

As discussed above, contrary to the position taken in the outstanding Office Action, Toya et al. does not disclose that the heating unit contained within the recess includes a tube and a carbon wire heater sealed within the tube. That is, Toya et al. does not disclose a recess into which a separately formed tube having a carbon heater therein is placed. Thus, the combination of Ogura et al. and Toya et al. do not disclose all the limitations of the independent claims of the present application.

³ See Office Action at page 3, lines 3-12.

Even assuming that all limitations of claim 1 can be gleaned from Ogura et al. and Toya et al., Applicants submit that there is no motivation to combine Ogura et al. and Toya et al. to arrive at the present invention. As noted above, the present invention is directed to improving a wafer heating assembly having a wafer support surface to provide more uniform heating characteristics of the wafer, reduced thermal budgets and faster throughput. The claimed combination of a carbon fiber heater within a tube and placed within the recess of a substrate holder provides these advantages. Ogura et al. discloses a conventional heated substrate holder using a metal heater designed to provide heating to extremely high temperatures, and does not address uniformity of heating, thermal budget or throughput. Although the secondary reference to Toya et al. discloses a carbon fiber heater generally, this carbon fiber heater is not provided within a substrate holder. A careful reading to Toya et al. reveals that each embodiment disclosed therein is directed to indirectly heating a wafer by placing the heating unit in a chamber wall or lid as described above.⁴ The only discussion of wafer heating is provided in relation to Figure 61 of Toya et al., which discloses that the carbon heater 220 is provided separately from the substrate holder 283. There is no hint or suggestion in Toya et al. (or Ogura et al.) to provide a carbon heater within a substrate holder as required by the claims. In fact, Ogura et al. and Toya et al. are directed to completely different problems and objectives from one another. Thus, there is no motivation to combine Ogura et al. and Toya et al. to arrive at the claimed invention.

For the reasons discussed above, Applicants' independent Claim 1 patentably defines over the cited references to Ogura et al. and Toya et al. Moreover, the remaining cited references in this case are provided for teachings of features within the dependent claims and do not correct the deficiencies noted above. Therefore, Applicants' independent claim

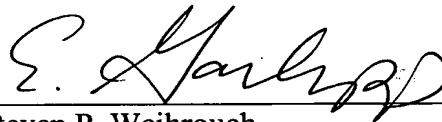
⁴ See, for example, col. 41, lines 55-67 and col. 56, lines 30-40, explaining indirect heating arrangements.

patentably defines over the cited references. As Claims 2-39 and 45 depend from Claim 1, these claims also patentably define over the cited references.

Consequently, in view of the present amendment, no further issues are believed to be outstanding in the present application and the present application is believed to be in condition for formal allowance. An early and favorable action is therefore respectfully requested.

Respectfully submitted,

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